the binder throat. For cutting corn by hand, a special low-cutting tool has been devised. Both the low-cutting binder attachment and the low-cutting hand tool are described, and directions for making them are given, in Miscellaneous Publication 56–M of the department. The attachments may also be obtained from the binder manufacturers.

After the corn is removed from the field, careful disposal of the fodder is necessary. The ensiling process of cutting the fodder into short lengths and blowing it into the silo, effects a high mortality. Should any borers escape the knives, the fermentation process in the silo will cause their destruction.

Another machine, the silage harvester, effects practically the same result if equipped with a low-cutting knife. This machine, which is pulled along the corn row by a tractor, cuts off the stalks at ground level and causes them to pass up a chute into a cutter head where they are cut into approximately one-half inch lengths. A conveyor passes the cut-up corn or silage into a wagon drawn beside the harvester, from which it may be blown into the silo.

The husker-shredder also effects a high mortality in borer-infested stalks. From many tests with used farmer-owned machines and with new machines working under various conditions, it was found that kills of 90 to 98 per cent were obtained when the fodder was fed uniformly, with the machine running at normal speed and adjusted for a high pressure on the snapping rolls. This pressure, of course, should not be sufficient to cause undue heating and damage to the snapping roll bearings. Borers not killed in the rolls, shredder head, or blower may become desiccated in the mow, eaten when fed to stock, or trodden under foot. Fodder passing through a shredder in proper adjustment can therefore be spread upon the fields with little danger. In using either the silage cutter or husker-shredder, care must be taken to dispose of the loose borers found under the machine or in the shelled corn.

In addition to the machines described above, various others have been tried out or are in process of development, all for the purpose of killing the borer. The area infested is increasing rapidly, and so is the intensity of infestation. However, because of the progress already made in developing control machinery, it is expected that effective equipment for preventing extraordinary damage will be available by the time that repressive measures must be adopted generally.

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CORN-BORER Control Much Facilitated by Deep, Clean Plowing

"Clean plowing—a sure means of controlling the European corn borer," is accepted at its face value by most authorities and is becoming a slogan for the Corn Belt. While no one method can best meet all conditions, the plow has been very useful in reducing the number of borers, which can not complete their life cycle underground or live on top of the

ground without protection from birds, other natural enemies, and the weather.

Clean plowing means the complete burial of all trash (figs. 31 and 32), which is necessary for absolute control. It is difficult to bury all the stalks and thoroughly clean fields are seldom found unless plowing has been followed by hand picking. In fact, the first surveys of infested fields made by the corn-borer control forces showed that the average farmer was leaving about 30 feet of cornstalks per square rod of field, which was enough to shelter more borers than were present in the stalks before plowing. Plowing has improved greatly since that time, and a survey in 1928 showed that in the average field in which whole stalks were plowed under 13.1 linear feet of stalks per square rod were unburied when the spring work was finished, no hand picking having been done. One-eighth of the original borers were hiding in these stalks, however, and since the offspring of this number of survivors would ordinarily show a large increase over the preceding year, much cleaner plowing than this is necessary. But the improvement already made, and the interest shown by farmers and manufacturers in better equipment to replace the old as it wears out, are indications of cleaner work in the future.

FIGURE 31.—Clean plowing to control the European corn borer

During the compulsory clean-up campaign of 1927 hand picking and burning were often required to clean fields where the stalks were not well buried by plowing, and this practice was quite effective in killing borers. However, it is tedious, disagreeable work, coming at a busy season, and farm operations should be planned for proper control without it, using methods adapted to the local situation.

Soil Type Affects Cleanness of Plowing

The value of plowing as a control measure depends on the completeness of burial of the trash, and that in turn depends on the nature of the soil and the efficiency of the plows used. Figures obtained in extensive tests on three common types of soils near Toledo, Ohio, show the relative difficulty of obtaining clean plowing. (Table 1.)

TABLE 1.—*Débris left uncovered after plowing under whole cornstalks, on certain types of soil*

Soil type	Average total length not covered, per square rod with—		
	Best plows [1]	Poorest plows [1]	All plows
	Feet	*Feet*	*Feet*
Sandy loam	0.44	3.34	1.89
Clay loam	2.65	9.91	6.75
Heavy clay	4.90	14.07	11.20

[1] Average for three plows.

The experiments from which these figures were obtained showed even more clearly than the tabulation that soil type and condition have a very large influence on cleanness of plowing. While Table 1 shows that there was six times as much material uncovered on the heavy clay and three and one-half times on the clay loam as was left on the sandy loam, field observations showed similar differences in favor of soils which were well supplied with organic matter and well drained.

FIGURE 32.—A field on which tests for trash coverage were made

Most sulky or tractor plows of 14-inch width or larger can be made to do satisfactory work on soils which are mellow, easily plowed, and pulverized, either because they contain a large amount of sand or organic matter or because they contain just the right amount of moisture. Plows should be equipped with rolling coulters, jointers, and covering wires, and operated at a depth of 7 inches or more. A skillful plowman can do very clean work with such an outfit in mellow soil, and the few stalks left uncovered may be picked up quickly by a man or boy as the plowing progresses, and thrown into the open furrow to be covered at the next round. The range of conditions under which stubble may be turned under satisfactorily is somewhat wider than for whole stalks.

On heavy, intractable soils, which break up in large tough slabs when plowed wet and in big clods when dry, it is almost useless to try to plow under whole stalks well enough for corn-borer control. The proper procedure is either to pole down the stalks when frozen, harrow down when dry, or cut off at ground level with a stalk shaver; then rake and burn them before plowing. Even if the raking and burning is not a really clean job it will enable the plow to complete a satisfactory measure of control more cheaply than the hand picking that would otherwise be necessary. This practice, of course, increases the need for soil-building crops in the rotation.

On intermediate soils, which can be fairly well pulverized under most conditions, one has the choice of first raking and burning the stalks

and using common plows, or of using the most efficient plows available to turn under the whole stalks.

Characteristics of a Good Corn-Borer Plow

For most efficient coverage, plows should be selected which have plenty of clearance between the beams for the passage of stalks and for setting the coulters and jointers to best advantage, because when jointers and covering wires are used there is a tendency for stalks to clog between the jointer and the beam ahead. (Fig. 33.) The plows should also be free from low cross braces and projecting parts that would catch and drag stalks. The hitch plates on a tractor plow should be adjustable low enough to hold the plow level when operating with the tractor drawbar set about 12 inches above the ground. Hitching high on either the tractor or the plow often causes uneven running and seriously interferes with good coverage.

Large plows, with 16-inch and 18-inch bottoms, as a rule have proven to be more satisfactory than smaller plows on easily pulverized and intermediate soils, though such is not always the case on heavy soils. The shape of the bottom is fully as important as the width, and a type should be selected that lifts the dirt well, curves the upper edge of the furrow slightly forward as it falls, and lays it smoothly against the crown of the preceding furrow. The plow should leave a clean, wide, open furrow, at least 10 inches at the bottom, into which stalks may be turned at the next round. The covering power of bottoms varies in different soils, and actual field trial is the best way to select the right bottom for the conditions.

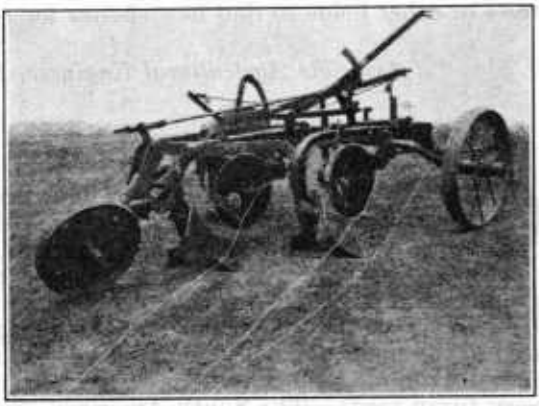

FIGURE 33.—A plow properly equipped for clean plowing, with large rolling coulters, jointers, and covering wires. Notice good clearance between the bottoms, and freedom from obstructions that might catch stalks

The plow should be provided with rolling coulters at least 15 inches in diameter; good-sized jointers, either in combination with the coulter, or standing; and a 10-foot covering wire fastened to each coulter shank and another to the axle of the furrow wheel, all of them arranged to drag over the turning furrow slices and keep the stalks from pitching. A good plow equipped in this way and carefully operated at a depth of 7 to 8 inches should turn under whole stalks on reasonably mellow soils to meet corn-borer control standards, unless weather conditions are unfavorable. High winds at the time of plowing will ruin the work of any plow, and even ordinarily mellow soils when too dry or too wet are difficult to plow cleanly.

Other Helpful Practices

Disking stalks before plowing is sometimes helpful. If the soil is dry and cloddy before plowing, disking may help the plow to pulverize it,

in that way improving coverage and at the same time cutting the stalks into short lengths that are not easily dragged out by the cultivator. On the other hand, if the ground is damp and heavy enough to pack, the disking may leave it more difficult to pulverize and thus hinder coverage. Rolling or dragging the stalks to lean them in the direction of plow travel is a benefit provided the stalks are not broken loose and the ground is not injured by packing. Extension rims on the land wheel of the tractor are sometimes of benefit, since they roll down the stalks and reduce soil packing. Where husking lands conform to plow lands the stalks are easier to turn under than where they are bent opposite to the direction in which the plow travels.

It is difficult to have headlands and backfurrows clean under any condition, as the ground is almost always packed on the headlands and it is impossible to place the stalks at the proper depth on the backfurrows. Disking or harrowing will bring them to the surface even if they appear nicely covered when plowing is finished. Therefore, the best way is to rake and burn these strips before plowing. If a 25-foot border around the entire field is treated in this way, it will dispose of most of the borers that might crawl out of the plowed land into fence rows or other fields to find new shelter for completing their life cycle.

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COTTON Breeding To-day Works with Main Types Known in Remote Past

There are two principal types of cultivated cottons — Asiatic and American. The American cottons may be classified roughly in two groups, the Mexican-Central American and the South American. Upland cotton (fig. 34) belongs to the first group, which is characterized in the main by whitish flowers without spots on the petals, large, smooth, rounded 4-lock or 5-lock bolls, relatively short, white lint, and very fuzzy seeds. The South American group, of which outstanding examples are the Sea Island, Egyptian, and Rough Peruvian cottons (fig. 35), is characterized in the main by yellow flowers with a dark red spot on each petal, rough, pointed, mostly 3-lock bolls, relatively long, cream or buff-colored lint, and smooth or only partly fuzzy seeds. The lengths of lint of these types are shown in Figure 36, and seeds are shown in Figure 37. Bolls characteristic of the two American groups are shown in Figure 38.

The Asiatic and the American cottons are so different that it is very difficult to make them cross or hybridize. On the other hand, it is easy to make crosses between any of the cultivated American cottons. This fact indicates that there is a closer relationship among the American species than between the American cottons in general and the Asiatic cottons.

When cotton plants first attracted the attention of civilized peoples, representatives of all the main groups were already in cultivation and probably had reached very nearly their present stage of development. Modern effort in the improvement of cotton, as of many other crop plants, has been largely a reworking of the materials bequeathed to us by the unknown plant breeders of the remote past.